Some Effects of Antibiotics in Surgery

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• Although surgical mortality has decreased considerably in the antibiotic era, infectious complications still head the list of causes of death after operation.

The choice of an antibiotic singly or in synergistic combinations should be governed by both the pathogenic organism and the organ involved. Allergy, toxicity and development of bacterial resistance are important limiting factors.

Besides oxygen, antibiotics are indicated in dealing with localized or generalized anoxia as encountered in vascular impairment of intestinal obstruction or in shock.

In acute abdominal conditions meticulous observation is required during the use of antibiotics in order to avoid dangerous delay of operation.

THE IMMENSE LITERATURE that has accumulated on the use of antibiotics contains much discussion of the relative merits of newer antibiotics in relation to preoperative and postoperative treatment. However, little is found on the effect of antibiotics on surgical procedures: How has the effect of antibiotics on postoperative complications — such as pneumonia, peritonitis or wound infections—influenced surgical indications? What is the influence of antibiotics on surgical timing and technique?

These questions will be discussed in this presentation, and the choice of antibiotics under specific conditions will be considered. (With apologies to purists, sulfonamides will be included at times.) Statistics will be but sparingly referred to, since it is impossible to exactly weigh the part played by antibiotics within the many variables of modern management.

EFFECT OF ANTIBIOTICS ON COMPLICATIONS; INDICATIONS FOR USE

Large surgical clinics[11] still report postoperative peritonitis and pneumonia as the chief causes of death. Unquestionably the incidence of these complications has been diminishing in recent years, but the reduction cannot be credited solely to the use of antibiotics. Better preparation of the patient for operation has made operation safer, while better physiological postoperative management has made extensive procedures safer for the patient. Experimental work on animals suggested the use of antibiotics in the presence of vascular impairment, for example, in intestinal obstruction[2, 3, 6, 10] or in hemorrhagic shock.[5] Avoidance of shock during operation, blood replacement, use of oxygen, and replacement of water, sodium and potassium without overdosage are known factors in the improvement of surgical results.

In general it may be said that the reasons for persistence of pneumonia and peritonitis or some other infections are:

1. Lack of correlation between the bacterial invader and the antibiotic chosen. (Studies to determine the sensitivity of the organism should be carried out, and broad spectrum antibiotics and combinations of synergistic antibiotics should be used.)

2. It must be stressed that once pulmonary edema, atelectasis or local inflammatory edema (as in an obstructed bowel) is established, the impairment of circulation through the infected area limits the local concentration of any antibiotic. Also, concentration of antibiotics varies considerably in different organs. This has been called "organ sensitivity" and could better be called "organ accessibility." The antibiotics of choice for access to various areas are listed in Table 1.

Experimental work on peritonitis suggests that crystalline penicillin is superior to procaine penicillin[1, 12] and that aureomycin given intravenously may be toxic in high doses[1] (100 mg. per kilogram of body weight). However, it must be emphasized that no known antibiotic will control a continuous leak from an abdominal viscus.[4] In such cases a treacherous period of initial improvement lasting several days will be followed by sudden deterioration with a flare-up of peritonitis, ileus, and death. This "escape" from antibiotic control can only be prevented by properly timed surgical intervention. Some of the modern day tragedies of surgery are brought about by a false sense of security obtained in the first few days of apparent improvement.

The routine postoperative use of antibiotics after operation, although not uniformly accepted, certainly has reduced the incidence of postoperative wound infection. Antibiotics have at times caused a delay in appearance of some postoperative ab-

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TABLE 1.—*Drugs of choice for dealing with infections in various organs.*

Organ or Site of Use	Drug of Choice
Peritoneum	Aqueous penicillin, streptomycin, aureomycin, Terramycin (erythromycin*)
Liver, gallbladder	Terramycin, streptomycin
Pancreas	Sulfonamides
Bowel	Sulfathalidine, sulfasuxidine Neomycin, streptomycin
Kidney	Terramycin, sulfisoxazole (erythromycin*)
Topical use	Neomycin, bacitracin, tyrothricin, gramicidin D, polymyxin B

*Further evaluation necessary.

scesses for six or eight weeks after operation, and a rise of temperature a few months after operation demands a search in this direction. Other disadvantages of antibiotics are the risk of allergic reactions, sensitization of the patient, secondary infections such as moniliasis after Terramycin or aureomycin, and development of bacterial resistance. Therefore, it may seem better in some circumstances to avoid antibiotics—for example, after simple hernioplasty in a young healthy person. On the other hand, in an old patient with bronchitis or cardiac damage the prophylactic use of antibiotics—say, 100,000 units of crystalline plus 300,000 units of procaine penicillin every 12 hours—is well justified. However, streptomycin should be omitted in prophylaxis since E. coli may develop resistance to the agent within two to three days.

Surgical Technique

It is impossible to see how it can be thought that antibiotics could obviate the need for properly used intra-abdominal drains after operations such as gastric resection or cholecystectomy or in the management of perforated appendix with local or diffuse peritonitis. Antibiotics will not prevent or cope with a duodenal blowout or a biliary leak, and a properly placed soft rubber drain or better suction through a double lumen tube may be life saving.

Giving sulfthaladine, sulfasuxidine, streptomycin, Terramycin, aureomycin or Neomycin by mouth for periods of from two to five days before operation has made colon resection safer. Today's good preparation of the bowel with antibiotics favors the open anastomosis technique and thus reduces the drawbacks of closed anastomosis—bleeding, diaphragm formation, stricture. In the absence of obstruction or edema, antibiotics have supported the trend toward one-stage resection with primary anastomosis; decompressing colostomy seems to be less frequently used.

Surgical Timing

That the preoperative use of antibiotics has influenced surgical timing is best illustrated by current practices in dealing with some of the most common acute abdominal conditions.

Perforated Peptic Ulcer

The use of antibiotics, such as penicillin, probably contributed most to the success of conservative treatment of gastric or duodenal perforations with the suction tube. Antibiotics also have considerably reduced the incidence of peritonitis after primary gastric resection in perforated peptic ulcers; and the low mortality and morbidity attest improved surgical management, with antibiotics playing a vital role. In addition to systemic use of penicillin, as discussed, 1,000,000 units of aqueous penicillin and 1 gm. of streptomycin can be instilled into the peritoneal cavity before closure.[8, 9]

Acute Appendicitis

Of particular value in dealing with a patient who is in poor condition for operation, preoperative administration of antibiotics will allow vital correction of cardiac failure or dehydration prior to operation. However, in appendicitis with perforation, delay should not exceed a few hours. How misleading an apparent initial therapeutic response may be is exemplified in the following case report.

CASE REPORT

The patient, a 9-year-old girl, had had diffuse abdominal pain and fever for five days when first observed. A physician administered intramuscular penicillin daily with some initial improvement. On the fifth day, when examined by the consulting pediatrician and by the surgeon, the patient had temperature of 104° F., symptoms of severe toxicity, nausea and abdominal distention. Operation was carried out immediately. Gangrenous appendicitis with multiple old perforations and local and diffuse peritonitis were observed. Appendectomy was performed and a double lumen drain was inserted behind the cecum. Aqueous penicillin and streptomycin were left in the peritoneal cavity before closure and these antibiotics also were given intramuscularly every six hours. There was profuse drainage through the abdominal tube for three days. Fever continued until bowel function resumed 48 hours after operation. The patient was discharged five days after operation.

This case raises the controversial question whether appendectomy should be performed in the presence of peritonitis. It is hard to see how gentle operation through a lateral McBurney incision could in any way contribute to the spread of infection. Modern antibiotics, lateral incision and postoperative drainage where an abscess is present will permit appendectomy in almost every stage of appendicitis. In some patients with a subsiding appendiceal mass or abscess, operation has considerably reduced the duration of morbidity, hospitalization and disability.

Acute Cholecystitis

In the management of acute cholecystitis, antibiotics can play only a subordinate role since chemical irritation and vascular thrombosis are the primary offenders, with only secondary bacterial invasion. Terramycin and aureomycin are well concentrated in the liver and bile, but the obstructive process prevents their concentration within the gallbladder.

Penicillin may reduce the inflammatory response of the omentum and bring about relaxation of the muscular rigidity and thus bring about conditions indicating improvement yet at times camouflaging silent perforations of a gangrenous gallbladder.

CASE REPORT

The patient, a man 62 years of age, was obese and diabetic. He had had right nephrectomy 18 years previously and wound abscess had occurred at that time.

The history of the present illness was that about five weeks before the patient was first observed by the author he had been admitted to a hospital with a diagnosis of acute cholecystitis. He was treated expectantly with intramuscular administration of penicillin. After ten days the tenderness in the right upper quadrant of the abdomen seemed subsided and the patient was sent home. Three weeks later he again had severe pain in the right upper quadrant and was treated at home with penicillin injections. Five days later the author examined the patient at home and recommended transfer to the hospital where for several more days antibiotics were given and fluids were infused to control severe dehydration. Although gradually the general condition appeared to improve, there was an impression that a mass in the right upper quadrant was enlarging.

To obviate the risk of diffuse peritonitis, operation was done. The gallbladder was covered by a heavy mass of omentum. It was thickened and gangrenous and many abscesses were present. An old subhepatic perforation of the gallbladder contained bile. The gallbladder was also adherent to the stomach, duodenum and adjacent structures. Dissection appeared difficult and hazardous and in order to avoid injury to the common duct only the lower half of the gallbladder was resected, leaving the necrotic wall of the gallbladder lying in the hepatic bed. A soft rubber drain was inserted between it and the liver for drainage and a second double lumen drain was placed into the area of the gallbladder. Postoperatively, suction yielded bile for five days. The patient received 400,000 units of fortified penicillin and 0.5 gm. of streptomycin intramuscularly every six hours. Fluids and insulin were given intravenously. The wound healed rapidly. The patient was discharged nine days after operation.

This case illustrates several points:

1. The timing of operation in acute cholecystitis may be made more difficult through the masking effect of antibiotics used preoperatively.

2. Antibiotics are of considerable value after operation and, along with proper suction drainage, they speed recovery and wound healing.

3. Diabetic persons are more prone to complications of gallbladder disease and therefore should be operated upon early in spite of apparent response to antibiotics.

Pelvic Operations

In pelvic inflammatory conditions antibiotics have made it possible to obtain primary healing during a short hospital stay if perforation of an ovarian abscess indicates operation. Penicillin therapy of salpingitis without operation has led to incomplete restoration of tubal patency and hence to increased incidence of tubal pregnancies.[7] In radical hysterectomy for cervical carcinoma antibiotics have almost eliminated postoperative pelvic cellulitis.

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